SUMMARY

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Purpose and Scope

Arrowrock Dam, completed in 1915, was constructed by the Bureau of Reclamation (Reclamation) as part of the Boise Project in southwest Idaho. The dam is located on the main stem Boise River about 17 river miles upstream from the city of Boise. Arrowrock Reservoir is operated as one of three storage facilities constructed on the Boise River. Anderson Ranch Dam and Reservoir, located on the South Fork Boise River and generally east of Arrowrock Dam, were completed by Reclamation in 1950 as part of the Boise Project. Lucky Peak Dam and Lake, located to the southwest and about 11 river miles downstream of Arrowrock Dam, were completed by the U.S. Army Corps of Engineers (Corps) in 1957. Reclamation and the Corps operate the three storage dams in a coordinated manner for irrigation water supply (Reclamation markets the water supply in Lucky Peak Lake for irrigation), flood control, recreation, and fish and wildlife.

The purpose of the proposed action is to enable Reclamation to continue to operate Arrowrock Dam and Reservoir to meet the project purposes of irrigation and flood control.

Alternative A is identified as the preferred and environmentally preferred alternative, in accordance with 40 Code of Federal Regulations (CFR) 1502.14(e) and *Departmental Manual* Part 516, Chapter 4, 4.10A.

This Final Environmental Impact Statement focuses on the potential effects of the No Action Alternative and two construction alternatives for replacing the lower row of Ensign valves with clamshell gates. The No Action Alternative consists of an aggressive maintenance program that would be implemented if the valves are not replaced.

Reclamation's scoping process included numerous meetings with Idaho State and Federal agencies, Indian Tribes, local groups, and interested individuals. Notices of intent to prepare an Environmental Impact Statement and to hold a public scoping meeting were published and a public scoping meeting was held on November 20, 1998. The results of meetings and comments have been considered in the development of the No Action and action alternatives.

Environmental effects of the No Action and action alternatives were analyzed for the stream reaches and reservoirs upstream and downstream from Arrowrock Dam and Reservoir. Environmental effects are generally limited to those associated with construction and the reservoir drawdowns necessary for maintenance and replacement of the lower outlets.

A Draft EIS, issued on October 23, 2000, provided the opportunity for public review and comment for a period of 60 days. Sixteen letters of comments were received. Main areas of concern were economics, safety, dissemination of information/status updates, repayment, water quality, fish, and recreation impacts. The text of this EIS has been revised as appropriate. The most significant change is the criteria for use of sluice gates in Alternative A. To mitigate for water quality, this change allows the work site to be flooded 5 days cumulatively before the

sluice gates are opened. As a result, the probability of using the sluice gates would be only 15 percent under Alternative A.

Need for Action

The current condition of the Arrowrock Dam outlet works presents an increasingly difficult maintenance problem. The Ensign valves, which control water releases from the dam, have been in use since 1915 and have exceeded their design life. Most of the Ensign valves have been damaged through prolonged use. Three valves that control flow through the middle row of conduits (lower row of Ensign valves) are currently out of service. The gates that control the sluice outlets, which are needed to empty the reservoir for inspection and maintenance of the lower level Ensign valves, are also damaged. Use of two of the five sluice gates is currently limited. Based on the results of the last inspection, major repairs and rehabilitation of the existing valves and sluice gates are needed to assure continued use over the long term.

Maintenance procedures, which call for inspection and repair of the lower row of Ensign valves every 6 years, require that Arrowrock Reservoir be drawn down to a very low level. Drawdown for inspection and repair is a problem because the sluice gates, which must be operated to lower the reservoir level, also need repair. There are also environmental concerns associated with the drawdown of the reservoir and use of the sluice gates. Use of the sluice gates causes turbidity downstream and sediment deposition in Lucky Peak Lake. Extreme drawdowns and use of the sluice gates for inspection and maintenance adversely affect bull trout, other fish, and water quality. Due to these concerns, and in anticipation of a long-term solution to the maintenance problem, Reclamation has deferred inspection and maintenance of the lower Ensign valves since 1988.

The condition of the lower Ensign valves inhibits Reclamation's ability to release sufficient flow to meet project purposes under some conditions. Due to susceptibility to damage, the lower row of Ensign valves cannot be used under high pressure conditions, e.g., when the reservoir is nearly full. In years with high runoff, this operational constraint reduces the ability to release water for flood control operations.

Restricted flow capacity is also a problem in drought years. This occurs when there is a low head differential between Arrowrock and Lucky Peak. Under that condition it is not possible to pass adequate flows through Arrowrock Dam while maintaining the Lucky Peak Lake **elevation** for recreation. When Arrowrock Reservoir is at a target conservation pool elevation of 3078 and Lucky Peak is at a full pool of 3055, the seven operational valves can only pass 2,900 cfs. That contrasts with an irrigation demand of about 4,300 cfs. The proposed clamshell gates will allow a release of about 5,000 cfs in this scenario.

Because of the condition and age of the valves it is possible that some of the lower valves could malfunction and stick in either the open or closed position, requiring unplanned reservoir drawdown to repair the valves. Valves stuck in either position would reduce flood control flexibility and could result in some increased downstream flooding. Stuck valves during the irrigation season could also affect irrigation water deliveries.

Alternatives

Two action alternatives have been identified to resolve problems associated with the Ensign valves. Facilities included in these two alternatives are identical, both require three construction seasons, and only the operation of reservoirs during the third year of the construction period differ. Alternative A features an Arrowrock Reservoir elevation greater than the No Action, with only a 15 percent chance of using the sluice gates to maintain reservoir elevation. In contrast, Alternative B features a much shorter reservoir drawdown than the No Action Alternative, but a lower reservoir elevation than Alternative A. Alternative A is Reclamation's Preferred Alternative.

Both action alternatives consist of replacing the 10 lower Ensign valves located on the upstream side of the dam with clamshell gates to be located on the downstream side of the dam. Associated structures and features include a control house and new gallery entrance for access to the clamshell gates, steel conduit liners, modified trashracks to accept a bulkhead gate for maintenance of the outlets, and a bubbler system to maintain an ice-free area of water around the guides of the bulkhead gate. Steel liners would be grouted in place. Bellmouths would be mounted on the upstream face of the dam in place of the Ensign valves and welded to the liners. Construction would require 3 years and a drawdown of Arrowrock Reservoir below normal operating levels in the third year to accommodate construction on the upstream face of the dam.

The top row of Ensign valves and the sluice gates would be abandoned. One or two of the Ensign valves removed from the lower row would be retained for subsequent use as an interpretive exhibit at a Reclamation facility.

No Action Alternative

The No Action Alternative is defined as "the most likely future without the proposed action" and is the baseline for evaluating the effects of the action alternatives. For this analysis, the No Action Alternative is not the status quo operation scenario of the past 10 years. Although the Standing Operating Procedures for Arrowrock Dam state that the Ensign valves are to be inspected every 6 years and repaired as necessary, maintenance on the lower outlets has been deferred since 1988 pending a resolution of maintenance and valve replacement options. Maintenance of the sluice gates has also been deferred since 1988. The No Action Alternative would consist of an aggressive maintenance program for the lower row of Ensign valves and the sluice gates.

The No Action Alternative consists of inspection and minor cavitation repair from November 1 through December 31 during the first maintenance season (Arrowrock Reservoir would be at elevation 3007 feet). See figure S-1 for a cross section of Arrowrock Dam and the reservoir elevations during the maintenance season. After the initial inspection and minor repair in the first maintenance season three or four Ensign valves would be completely overhauled and the remaining valves would be inspected and minor repairs made at each subsequent maintenance drawdown. At the next maintenance drawdown (2 years after the first maintenance drawdown), Arrowrock Reservoir would be drafted to elevation 2975 feet from October 1 through February 28. Every sixth year for the life of the project, there would be a maintenance drawdown

extending from October 1 through February 28. Reservoir elevations during maintenance drawdowns would alternately be at 3007 feet and 2975 feet. The sluice gates would be inspected and two or three sluice gates would be overhauled or repaired as necessary during maintenance drawdowns to elevation 2975 feet.

The No Action Alternative would assure that every lower Ensign valves is overhauled once every 18 years and that sluice gates are inspected and repaired as necessary once every 12 years.

Maintenance activities related to the upper row of Ensign valves would continue as in the past and are included in the cost of the No Action Alternative. However, no description is included here because reservoir drawdowns lower than normal operation are not needed for work on the upper valves.

A 50-year life cycle cost analysis was made for the No Action Alternative. Capital costs are estimated at $34,300,000. This includes all of the costs for periodic inspection and repair of the outlet facilities until all are fully operational. The present worth value for comparison with the action alternatives is $11,000,000.

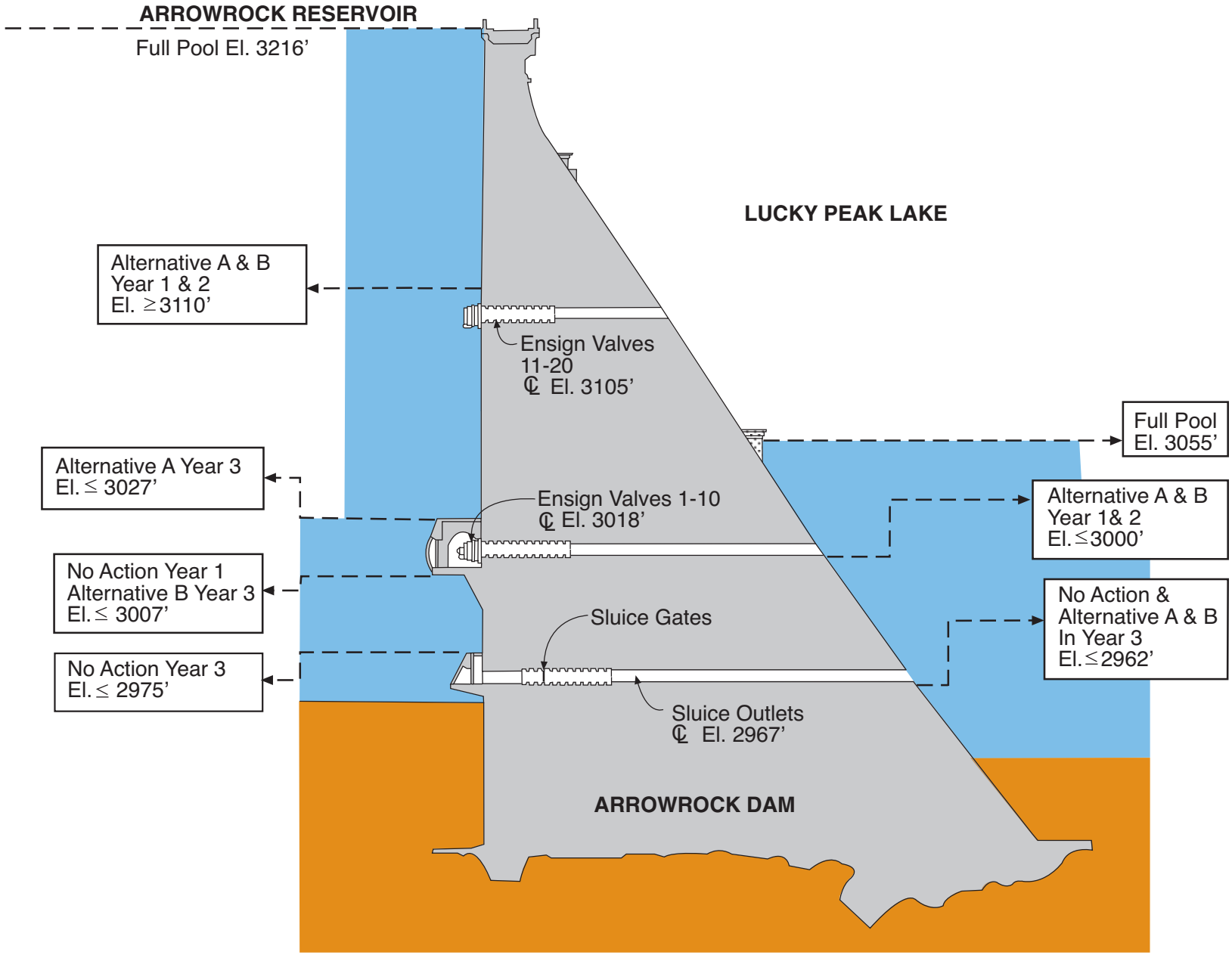
Accumulated annual operation, maintenance, and replacement costs are estimated at $1,000,000 over a 50 year-period and are based on the costs of periodic inspection and repair as necessary after the facilities are made fully functional. From an economic viewpoint it becomes problematic to separate operating and capital replacement costs to maintain and repair machinery that is very old. In addition there is some risk that eventually the required pieces and parts may not be found or may not be remanufactured at reasonable prices.

Alternative A (Preferred Alternative)– Replace Lower Row of Ensign Valves with Clamshell Gates, Arrowrock Reservoir Elevation 3027 Feet in Construction Season 3

Alternative A consists of three construction seasons and provides the largest possible pool for Arrowrock Reservoir (1,500 acre-feet) in the third season while still allowing valve replacement in a dry condition (see figure S-1). During the first two construction seasons, work would be limited to the downstream face of Arrowrock Dam. During these construction seasons (September 15 to March 1), Arrowrock Reservoir would be held at an elevation no lower than 3110 feet and Lucky Peak Lake would be held at an elevation no higher than 3000 feet. These elevations provide a means of moving water downstream as needed to meet irrigation demand and to provide flood control.

In the third construction season, Arrowrock Reservoir would be drawn down to an elevation no higher than 3027 feet from September 15 to February 28. Lucky Peak Lake would be held at an elevation no higher than 3000 feet from September 15 to October 31 and 2962 feet from November 1 to March 1. These elevations would allow work to proceed on the upstream side of Arrowrock Dam in the dry with bulkheads in place and to pass flows downstream.

At least six of the conduits now controlled by Ensign valves would be operational at all times to pass Arrowrock Reservoir inflow. Because of potential storm events during the construction season, it is estimated that the sluice gates may need to be opened temporarily to pass flows.



RESERVOIR ELEVATIONS
ARROWROCK DAM CROSS SECTION

Figure S-1

Mitigation for Alternative A allow flooding of the work area for up to 5 cumulative days before the sluice gates would be operated. As a result, there is only 15 percent chance that the sluice gates would be opened during the third construction season.

After completion of construction, neither Arrowrock Reservoir nor Lucky Peak Lake would need to be drawn down for maintenance work associated with Arrowrock Dam outlets.

The capital cost of Alternative A is estimated at $15 million, and annual operation, maintenance, and replacement costs for a 50-year period are estimated at $564,000. The present worth value of the capital cost for comparison with the No Action Alternative is $12,900,000.

Alternative B – Replace Lower Row of Ensign Valves with Clamshell Gates, Reservoir Elevation 3007 feet in Construction Year 3.

Alternative B is identical to Alternative A in facilities and in construction through the second construction season. Drawdown of Arrowrock Reservoir for the third construction season would be earlier, to a lower level, and for a shorter period than Alternative A (see figure S-1).

In the third construction season, Arrowrock Reservoir would be drawn down to elevation 3007 feet from September 1 to November 7. During this period, Lucky Peak Lake would be held at an elevation no higher than 2962 feet. These elevations would allow work to proceed much more quickly on the upstream side of Arrowrock Dam as bulkheads would not be needed to work in the dry.

The Alternative B trade-off for being able to work more quickly is that Arrowrock Reservoir would have a pool of only 160 acre-feet and the sluice gates would be used continuously during the drawdown to pass inflow. Because of the relatively short and early construction season, it is unlikely that potential storm events would exceed the capacity of the sluice gates and flood the work area.

After completion of construction, neither Arrowrock Reservoir nor Lucky Peak Lake would need to be drawn down for work on the Arrowrock Dam outlets.

The capital cost of Alternative B is estimated at $14.6 million, and annual operation, maintenance and replacement costs for a 50-year period are estimated at $564,000. The capital cost of Alternative B may be somewhat less than Alternative A. The present worth value of the capital cost for comparison with the No Action Alternative is $12,500,000.

Alternatives Considered But Not Carried Forward

Reclamation began considering modification of Arrowrock Dam outlet works in 1982; some conceptual designs for replacement of some of the Ensign valves were developed in 1983. Increasing maintenance problems resulted in more intense efforts to identify and evaluate solutions to the maintenance problems associated with the now 85-year old Ensign valves. In the following years, various possible designs were identified and evaluated, and in 1987 a conceptual design suggested clamshell gates. Other potential elements, features, and construction methods,

were also identified and evaluated. In the 1990's the focus has been on limiting reservoir drawdown and potential impacts to water supply and natural resources.

Construction periods of 2 years and 4 years with various measures to maintain higher pool elevations were identified and analyzed. All 2-year construction alternatives were eventually eliminated as too short to feasibly complete construction. All 4-years construction periods using a cofferdam, a pressure vessel, and divers were rejected. A cofferdam is not considered practical due to concrete deterioration and associated potential for leakage and concerns for safety to workers. A pressure vessel was rejected on the basis of extraordinary costs. Use of divers was rejected on the basis of cost and inability to meaningfully improve Arrowrock Reservoir water level elevation during construction.

Affected Environment

Reservoir Operations

The three storage dams on the Boise River system are cooperatively operated for irrigation water supply and flood control. To the extent possible within those parameters, the storage reservoirs are also operated for fish and wildlife, recreation, and water quality enhancement. Approximately 40,000 acre-feet of water have been annually released from the Boise River in recent years for anadromous salmon flow augmentation in the lower Snake River. Power production at Anderson Ranch Powerplant and Lucky Peak Powerplant are incidental to other operations, i.e., water is neither retained nor released specifically for power generation.

Total active storage capacity of the system is 960,000 acre-feet. Flood control operations during the winter through June determine water content particularly in Arrowrock Reservoir and Lucky Peak Lake. At the same time, the reservoirs are filled within flood control parameters to meet irrigation water supply needs. During reservoir draft to supply irrigation demands, Anderson Ranch and Arrowrock Reservoirs are drawn down first. Lucky Peak Lake is maintained as high as possible through the recreation season, but is usually rapidly drawn down after Labor Day to meet irrigation needs downstream. From September to March, Arrowrock Reservoir elevation normally ranges from 3184 to 3078 feet and Lucky Peak Lake elevation normally ranges from 2972 to 2943 feet.

Water Quality

Water quality is normally good throughout the system downstream to the city of Boise. Water quality degrades further downstream due to storm runoff, treated effluent, municipal contributions, and irrigation return flows. Because of water quality concerns, total maximum daily loads have been defined for sediment and bacteria for the lower Boise River.

Threatened and Endangered Species

Four species listed as threatened or endangered under the Endangered Species Act may occur in the affected area. These are bull trout, bald eagle and Ute ladies' tresses which are listed as threatened and the gray wolf which is listed as endangered.

Bull trout are the primary concern and are found in Arrowrock Reservoir and upstream in the South Fork (including Anderson Ranch Reservoir), Middle Fork, and North Fork of the Boise River. Movements of bull trout, which are sometimes entrained through Arrowrock Dam into Lucky Peak Lake, have been and continue to be studied. Adfluvial forms mature over a period of years in a lake or reservoir, migrate upstream to spawn and return to reside in the lake or reservoir for about 6 months each year. These forms are found in Anderson Ranch and Arrowrock Reservoirs. Bull trout that are entrained into Lucky Peak Lake are lost to the reproducing population. Reclamation is required under a 1999 biological opinion of the U.S. Fish and Wildlife Service to eliminate or reduce bull trout entrainment and to develop a minimum conservation pool at Arrowrock Reservoir.

Five bald eagle nesting pairs are found in the area; three upstream of Anderson Ranch Dam and two at Arrowrock Reservoir. Wintering bald eagles are found throughout the system from Anderson Ranch Reservoir to the lower Boise River.

Gray wolves have been documented in the North and South Fork Boise River drainages and there are unconfirmed reports of wolves near Arrowrock Reservoir and Lucky Peak Lake.

Ute ladies' tresses, a perennial orchid that grows in wetland and riparian habitat, has been recorded in Idaho but only in the eastern part of the state.

Although not found in the Boise River, Snake River spring/summer chinook, fall chinook, and steelhead are also a consideration as water from the Boise River is used for salmon flow augmentation in the lower Snake River.

Fish

In addition to bull trout, numerous fish are found in the reservoirs and various reaches of the Boise River. These include cold water and warm water species such as rainbow trout, mountain whitefish, smallmouth bass, and yellow perch. The rainbow trout fishery is supported primarily by stocking, although some wild redband trout are present. Arrowrock Reservoir has in recent years been annually stocked with an average of 120,000 rainbow trout fingerlings, 15,000 Kamloops/steelhead hybrids, and 8,000 fall chinook salmon fingerlings. Nongame fish species found in the reservoir include largescale sucker, bridgelip sucker, northern pikeminnow, redside shiner, chiselmouth, sculpins, and dace.

Vegetation and Wildlife

The shoreline of the reservoirs is generally devoid of riparian vegetation due to fluctuations in reservoir elevations. The hills surrounding the reservoir are generally covered with a sagebrush steppe community, and river reaches tend to have a well developed riparian community that includes black cottonwood.

Wildlife, in addition to endangered and threatened species, include migratory herds of mule deer and elk, waterfowl, shorebirds, and upland birds. More than 150 species of birds, 37 species of mammals, and a variety of reptiles and amphibians are found along the rivers.

Recreation

All of the reservoirs provide flatwater boating, fishing, camping, and other recreation opportunities. As the water level of the reservoirs decline through the summer, recreation opportunities and quality of experience diminish. Lucky Peak Lake provides the greatest recreation opportunities and serves one of the largest populations centers in the State of Idaho. River reaches are also used extensively including the reach that runs through the city of Boise.

Economics

The population of the three-county area–Ada, Canyon, and Elmore–is about 426,000; total population of the State of Idaho is about 1.2 million. Services, retail trade, and manufacturing are the dominant employment sectors. Although farms and agricultural services account for only 4.1 percent of the employment, much of the land and 90 percent of the water of the Boise River storage system are used for irrigated agriculture.

There are two large hydroelectric powerplants in the areas. Anderson Ranch Powerplant is owned and operated by Reclamation, and Lucky Peak Powerplant is owned by several irrigation districts and operated by Seattle City Light, a department of the city of Seattle. Annual generation of the two larger powerplants, Anderson Ranch and Lucky Peak, have averaged 153,562 megawatt-hours and 350,000 megawatt-hours respectively in recent years.

Cultural Resources

Arrowrock Dam is listed in the National Register of Historic Places for its significance in engineering and regional agricultural growth.

There are some recorded prehistoric sites in the vicinity of Arrowrock Dam and Reservoir. Of particular note, is a temporary Indian encampment established in the 1860's near the mouth of the South Fork Boise River. It is suspected that the site may contain burials. The Shoshone-Paiute and Shoshone-Bannock Tribes regard that site and possibly other sites below the full pool elevation of Arrowrock Reservoir as having traditional cultural, religious, and historic values.

Reclamation commits to further consultation with the affected Tribes on a government-to-government basis to avoid, minimize, or mitigate effects in accordance with 36 CFR 800, Executive Order 13007, and Reclamation policy. Consultations will include traditional cultural properties and sacred sites.

Indian Trust Assets

The Shoshone-Bannock Tribes located at the Fort Hall Reservation may have trust assets of hunting and fishing rights in the area. The Shoshone-Paiute and Shoshone-Bannock Tribes have strong cultural and religious interest in the area of Arrowrock Dam.

Indian Sacred Sites

The area around what is now Arrowrock Reservoir, including lands below the full pool elevation is regarded by the Shoshone-Paiute and the Shoshone-Bannock Tribes as having sacred value, particularly the location of the 1860's encampment at the mouth of the South Fork Boise River. The site may contain burials.

Environmental Consequences

Facilities, costs, economic effects, and environmental effects are listed in the Table S-1.

- Areas, resources, and operations not impacted or not measurably impacted by any of the alternatives include:
  - Flood Control operations, salmon flow augmentation ,wetlands, air quality, noise, and social conditions
  - Anderson Ranch Reservoir and the South Fork Boise River from Anderson Ranch Reservoir to Arrowrock Reservoir and the resources within those areas.
  - Environmental Justice
  - Gray wolf and Ute ladies' tresses
  - Snake River spring/summer chinook, fall chinook, and steelhead
  - Vegetation
  - Irrigation water supply (except in a very dry period)
  - Indian Trust Assets

Impact highlights

- Arrowrock Reservoir
  - Alternative A and B would result in only 1 drawdown compared to No Action with 9 drawdowns in 50 years
  - Alternative B drawdown would be deeper but of shorter duration than Alternative A

- Lucky Peak Lake
  - Alternative A and B would result in only 3 drawdowns compared to No Action with 9 drawdowns in 50 years
  - Alternative B drawdown in the third year would be start sooner and be for a shorter period than Alternative A

- Water Quality
  - Water quality impacts of each alternative could affect Arrowrock Reservoir (increases in turbidity and total suspended solids), Lucky Peak Lake (increases in turbidity and total suspended solids), and the lower Boise River (Total Maximum Daily Loads would likely be exceeded)
  - Water quality impacts of Alternatives A and B would be less than No Action
  - Alternative A water quality impacts would be less than Alternative B (less than 15 percent change of operating the sluice gates) and likely to be somewhat less in Lucky Peak Lake and the lower Boise River (Total Maximum Daily Load may be exceeded)

- Threatened and Endangered Species
  - Bull Trout
    - All alternatives would risk loss of bull trout by stranding, mortality, and entrainment. Alternatives A and B would result in less risk of loss than No Action
    - Alternative A may result in less risk of loss than Alternative B
  - Bald Eagles
    - All alternatives would risk some loss of nesting productivity of bald eagle pairs at Arrowrock Reservoir
    - Alternatives A and B could result in short term loss of nesting productivity versus long term loss under No Action
    - All alternatives would reduce foraging opportunities for wintering bald eagles in some areas and enhance foraging opportunities in other areas. No Action would have the most adverse effect

- Arrowrock Reservoir Fishery
  - All alternatives would temporarily eliminate most of the Arrowrock fishery (entrained to Lucky Peak Lake and/or killed due to high levels of suspended sediment). Mitigation measures (for stocking rainbow trout) could result in recovery in 2-3 years; 1-4 years recovery for non-game fish
  - Alternatives A and B would be less adverse than No Action
  - Alternative A impacts would be less adverse than Alternative B (due to a shorter period of high levels of suspended solids and only a 15 percent probability of using the sluice gates)

- Lucky Peak Lake Fishery
  - Fish kills could be expected with No Action and Alternative B, but Alternative B impact would be less than No Action
  - Alternative A could temporarily enhance the fishery due to entrainment from Arrowrock Reservoir; fish kills due to suspended solids are not likely

- Wildlife
  - All alternatives would have minor impacts on wildlife, temporary loss of open water habitat for waterfowl, enhanced feeding opportunity for shore birds, and hampered foraging by fish eating species
  - Alternative A and B impacts, adverse and beneficial, would be less than No Action
  - Alternative A impacts on foraging of fish eating species would be less than Alternative B

- Recreation
  - All alternatives would have a minimal adverse effect on recreation at Arrowrock Reservoir.
  - Alternative A and No Action would have minimal adverse impacts at Lucky Peak Lake compared a significant adverse impact in 1 year for Alternative B.
  - No Action would have no impact on recreation in the lower Boise River compared to a significant 1-year adverse impact for Alternatives A and B. The adverse impacts of Alternative B would be about 4 fold of Alternative A

- Economic
  - Irrigation Economics
    - All alternatives would result in a minor (too small to calculate) adverse impact
    - Alternative A and B impacts would be less than No Action
  - Hydropower Economics
    - All alternatives would result in a minor loss of hydropower generation
    - Economic value lost compared to No Action would be $740,000-$1,285,000 for Alternative A and $1,115,000-$1,786,000 for Alternative B over a 4-year period
  - Recreation Economics
    - No Action would have a minimal impact on recreation.
    - Alternative B would result in an economic loss of about $5 million compared to $314,100 for Alternative A

- Financial Effects
  - Arrowrock Reservoir space holders would repay 46 percent of the costs, the remaining 54 percent of costs would be paid by the United States
  - Alternative A and B financial obligation of Arrowrock Reservoir spaceholders would be about $6.9 million and $6.7 million respectively compared to a $15.6 million obligation for No Action

- Cultural Resources
  - All alternatives would incrementally increase the potential adverse impacts to archeological and traditional cultural properties through exposure of usually inundated terraces to vandalism or looting, and perhaps also new or different erosional processes. Impacts would be mitigated for in all alternatives
  - Alternatives A and B would have less potential for adverse impact than No Action
  - Alternatives A and B would adversely impact the historic integrity of Arrowrock Dam, which is listed on the National Register of Historic Places. Impacts would be due to removal of original valves and associated equipment and placement of new features on the dam exterior. Impacts would be mitigated

- Indian Sacred Sites
  - All alternatives would incrementally increase the potential to impact Indian sacred sites through physical disturbance due to erosion, looting, and vandalism in the Arrowrock Reservoir pool. Impacts would be mitigated for all alternatives
  - Alternatives A and B would have less potential for adverse impacts than No Action

- Indian Trust Assets
  - May impact the populations of fish and other game to some extent. Access to hunting and fishing areas would not be affected. None of the alternatives would affect tribal hunting and/or fishing rights.

- Cumulative Effects
  - No significant cumulative effect to any resource category.

Summary Table

Table S-1. Summary of Alternatives			
	Alternative		
Item	No Action	A (Preferred)	B
Facilities			
Spillway	No change	No change	No change
Upper row of Ensign valves	Retained	Abandoned but left in place	Abandoned but left in place
Lower row of Ensign valves	Retained	Replaced with clamshell gates	Replaced with clamshell gates
Sluice gates	Retained	Abandoned but left in place	Abandoned but left in place
Construction or Major Maintenance			
50 year period	9 years (Years 1, 3, and every sixth year thereafter)	3 construction seasons (parts of 4 water years)	3 construction seasons (parts of 4 water years)
Scheduled Arrowrock Reservoir Elevations (Elevations reflect Water/Reservoir Operations Modeling)			
Total drawdowns (50-year period)	9	1	1
Year 1 (elevation)	3007 feet for 2 months	>3110 feet	>3110 feet
Year 2 (elevation)	Normal operation	>3110 feet	>3110 feet
Year 3 (elevation)	2975 feet for 5 months	3027 feet for 5½ months	3007 feet for 9 weeks
Year 9, 21, 33, 45 (elevation)	3007 feet for 5 months	Normal operation	Normal operation
Years 15, 27, 39 (elevation)	2975 feet for 5 months	Normal operation	Normal operation
Scheduled Lucky Peak Lake Elevations (Elevations reflect Water/Reservoir Operations Modeling)			
Total drawdowns (50-year period)	9	3	3
Year 1 (elevation)	2962 feet for 3 months (October 7-December 31)	3000 feet for 5½ months (September 15-March 1)	3000 feet for 5½ months (September 15-March 1)
Year 2 (elevation)	Normal operation	3000 feet for 5½ months (September 15-March 1)	3000 feet for 5½ months (September 15-March 1)
Year 3 (elevation)	2962 feet for 5 months (beginning October 1)	2962 feet for 5½ months (September 15-March 1)	2962 feet for 9 weeks (beginning September 1)
Year 9, 15, 21, 27, 33, 39, 45 (elevation)	2962 feet for 5 months (October -March 1)	Normal operation	Normal operation

Table S-1. Summary of Alternatives			
Item	Alternative		
	No Action	A (Preferred)	B
Cost			
Capital (present worth)	$11,000,000	$12,900,000	<$12,500,000
Capital (50-year life cycle)	$34,300,000	$15,000,000	< $14,600,000
Operation, maintenance, and replacement (50-year total)	$1,000,000	$564,000	$564,000
Water Quality			
Arrowrock Reservoir			
Years affected	9 of 50 years	1 year	1 year
Pool size	0 and 160 acre-feet in alternate drawdowns	1,500 acre-feet	160 acre-feet
Sediment outflow	<520 to 1,250 acre-feet (each drawdown)	0 to 10.5 acre-feet	Up to 1,250 acre-feet
Turbidity and total suspended solids	Temporary increases (each drawdown)	Temporary increases (less than No Action and B)	Temporary increases for shorter duration than No Action and A. (less than No Action)
Lucky Peak Lake			
Sediment inflow	<520 to 1,250 acre-feet in 9 of 50 years	0 to 10.5 acre-feet in 1 year	Up to 1,250 acre-feet in 1 year
Sediment accumulation	<345 to 830 acre-feet in 9 of 50 years	0 to 7.5 acre-feet in 1 year	Up to 830 acre-feet in 1 year
Turbidity and total suspended solids	Increases concentrations	Low levels unless sluice gates are operated	Increased concentrations
Total dissolved gases	Continued occasional elevated levels	Temporary increase in two construction seasons, long-term decrease	
Lower Boise River			
Main stem–Turbidity and total suspended sediment	Exceed turbidity standard and Total Maximum Daily Load targets in 9 of 50 years	Turbidity standard and Total Maximum Daily Load targets unlikely to be exceeded. May exceed 1 year if sluice gates required	Exceed turbidity standard and Total Maximum Daily Load targets in 1 year (shorter duration than No Action)
Lake Lowell–Turbidity and total suspended solids	Increased in 9 of 50 years	Probably no increase	Increase in 1 year
Anderson Ranch Reservoir, South Fork Boise River, and other Stream Reaches – No Impacts			

Table S-1. Summary of Alternatives			
	Alternative		
Item	No Action	A (Preferred)	B
Endangered and Threatened Species			
Bull Trout			
Mortality Risk			
Arrowrock Reservoir	High	Moderate	High
Lucky Peak Lake	Low[1]	Low[1]	Low[1]
Entrainment			
Arrowrock Reservoir	High	High (less than No Action)	High (less than No Action, greater than A)
Lucky Peak Lake	Low	Low	Low
Food Supply			
Arrowrock Reservoir	Total loss, 1-4 year recovery	Near total loss, 1-4 year recovery	Total loss, 1-4 year recovery
Lucky Peak Lake	Short term reduction	Minimal impact	Short term reduction
Bald Eagles			
Arrowrock Nesting Pair			
Food supply	Periodic short-term and long-term reduction	Short-term reduction	Short-term reduction
Productivity	Potential loss in 9 of 50 years	Potential loss (less than No Action and B)	Potential loss (less than No Action, greater than A)
Wintering Eagles			
Foraging opportunity	Degraded in some areas, enhanced in others (9 of 50 years)	Degraded in some areas, enhanced in others (less effect than No Action and B)	Degraded in some areas, enhanced in others (less effect than No Action, greater than A)
Gray wolf	No effect		
Ute ladies'-tresses	No effect		
Snake River salmon and steehead	No effect		

Table S-1. Summary of Alternatives			
Item	Alternative		
	No Action	A (Preferred)	B
Other Game Fish			
Arrowrock Reservoir (risk of loss)	Significant for 2-3 years of every 6 year period	Significant for 2-3 years	Significant for 2-3 years (greater than A)
Lucky Peak Lake	Significant impacts from turbidity, 1 year of every 6-year period	Likely no effect	Significant impacts from turbidity for 1 year
Vegetation and Wildlife			
Waterfowl (loss of open water habitat)	Fall and winter of 9 of 50 years	Fall and winter of 1 year	Fall of 1 year
Shorebirds (foraging opportunity)	Enhanced in fall of 9 of 50 years	Enhanced in fall of 1 year	Enhanced in fall of 1 year
Fish eating species (foraging opportunity)	Hampered due to turbidity increase in 9 of 50 years	Hampered in 1 year (less effect than No Action and B)	Hampered in 1 year (less effect than No Action)
Vegetation	Minor clearing of upland areas for construction staging		
Irrigation Water Supply Shortage[2]			
Number of times	9 in 50 years	1 year	1 year
4-year Cumulative Shortage – Total Shortages			
Wet period	65,200 acre-feet	None	None
Average period	121,600 acre-feet	55,000 acre-feet	None
Dry period	550,100 acre-feet	478,700 acre-feet	403,300 acre-feet
4-year Cumulative Shortage – Specifically Due to the Alternatives			
Wet period	Not applicable	0 acre-feet	0 acre-feet
Average period	Not applicable	55,000 acre-feet	0 acre-feet
Dry period	Not applicable	81,000 acre-feet	5,600 acre-feet
Recreation Effects			
Arrowrock Reservoir (recreation-days)	Minimal loss in 9 of 50 years	Slight increase in 2 years, slight loss in 1 year	Slight increase in 2 years, slight loss in 1 year
Lucky Peak Lake (recreation-days)	Minimal loss in 9 of 50 years	Slight loss in 3 years	Minor loss in 2 years -103,100 in 1 year
Lower Boise River (recreation-days)	None	Significant loss in 1 year -43,750 in an average to dry year -175,000 in a wet year	Significant loss in 1 year -175,000 in a wet, average, or dry year
Anderson Ranch	Slight increase in recreation use		
South Fork Boise River	No change in recreation use		

Table S-1. Summary of Alternatives			
	Alternative		
Item	No Action	A (Preferred)	B
Economic Effects			
Irrigation	Minor impacts in 9 of 50 years (not meaningful to calculate)	Minor impact in 1 year (less than No Action)	Very minor impact in 1 year (less than No Action and Alternative A)
Hydropower (4-year period) – Lucky Peak and Anderson Ranch Powerplants			
Generation	1,772,585 megawatt-hours	1,749,642 megawatt-hours	1,744,015 megawatt-hours
Economic value Low High	 $45.6 million $74.4 million	 $44.9 million $73.1 million	 $44.5 million $72.6 million
Incremental value (compared to No Action) High Low	 not applicable not applicable	 -$740,000 -$1,285,000	 -$1,115,000 -$1,786,000
Recreation			
Arrowrock Reservoir	Very minor negative impact in late season in 9 of 50 years	Slight positive impact in 2 years and slight negative impact in 1 year	Slight positive impact in 2 years and slight negative impact in 1 year
Lucky Peak Lake	Minimal negative impact in 9 of 50 years	Minimal negative impact	Significant benefit loss of $3,702,900 due to reduced access to facilities
Lower Boise River	No effect under average water conditions. Negative effect during a wet year	Benefit loss of $314,100 in an average or dry year Benefit loss of $1,256,500 in a wet year	Benefit loss of $1,256,500 in an average or wet year
Anderson Ranch Reservoir	Slight positive impact to late season recreation use compared to normal operations due to higher reservoir elevation		
South Fork Boise River	No effect to slight positive impact		
Total recreation monetary loss	None	-$314,100 in an average or dry year -$1,256,500 in a wet year	-$4,959,600
Financial Effects (Capital Costs)			
United States obligation (54 percent of costs)	$18. 4 million over 50-year life	$8.1 million	$7.9 million
Arrowrock Reservoir spaceholder obligation (46 percent of costs)	$15.6 million paid over 50-year project life	$6.9 million paid through construction period	$6.7 million paid through construction period

Table S-1. Summary of Alternatives			
Item	Alternative		
	No Action	A (Preferred)	B
Effects on Cultural Resources			
Archeological Sites/Traditional Cultural Properties			
Potential for physical disturbance due to erosion	Yes	Yes (less than for No Action and B)	Yes (less than for No Action)
Potential for looting or vandalism	Yes	Yes	Yes
Historic Dam	Minor, non-visible impact	Removal of original elements and alteration of appearance. Largely mitigated	
Effects on Indian Sacred Sites			
Potential for physical disturbance due to erosion	Yes	Yes (less than for No Action and B)	Yes (less than for No Action)
Potential for looting or vandalism	Yes	Yes	Yes
Effects on Indian Trust Assets			
Right to hunt and fish	No Effect		
Cumulative Effects			
Resources	No significant cumulative effect to any resource category		

[1]Higher risk for fish near Arrowrock Dam due to higher turbidity levels.
[2]Total annual diversion total by water condition are: wet period – 1,300,000 acre-feet; average period – 1,550,000 acre-feet; and dry period – 804,000 acre-feet.